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THE NEED OF PROTECTING PERMANENT GRASSLANDS AS A PREMISE FOR THE DEVELOPMENT OF ORGANIC MEADOW FARMS

Summary

The area and productive use of permanent grasslands decrease in Poland. The main reason is a small stock of ruminants – the main biomass consumers. Meadow sward and soil become degraded, which results in economic losses and in the worsening of protective functions of grasslands with respect to natural environment of rural areas. There is an urgent need of grassland protection and of maintaining their both functions: economic and biological. A chance might be sought in meadow organic farms based on sustainable plant and animal production that does not disturb biological equilibrium. The precondition of rational and profitable grassland management is the improvement of technology and its implementation by farmers. Profitability of meadow organic farms should be guaranteed by subsidies as a compensation for services for the common good i.e. management under limitations arising from environmental protection.
Key words*: economic and biological importance of permanent grasslands, abandoned use of meadows and pastures, degradation of rural areas, meadow organic farm*

POTRZEBA OCHRONY TRWAŁYCH UŻYTKÓW ZIELONYCH JAKO PRZESŁANKA ROZWOJU ŁĄKARSKICH GOSPODARSTW EKOLOGICZNYCH

Streszczenie

Powierzchnia i wykorzystanie produkcyjne trwałych użytków zielonych w Polsce zmniejsza się. Główną przyczyną jest mała obsada przeżuwaczy, głównego odbiorcy biomasy. Następuje degradacja runi i gleby, zachodzą straty ekonomiczne i pogarszają się funkcje ochronne w stosunku do środowiska przyrodniczego obszarów wiejskich. Zachodzi potrzeba ich ochrony i utrzymania ich obu funkcji: gospodarczej i przyrodniczej. Szansą mogą być łąkarskie gospodarstwa ekologiczne, których podstawą jest zrównoważona w obrębie gospodarstwa produkcja roślinna i zwierzęca, nienaruszająca równowagi przyrodniczej. Warunkiem racjonalnej i opłacalnej gospodarki na TUZ jest doskonalenie technologii produkcji i wdrażanie ich wśród rolników. Gwarantem opłacalności łąkarskich gospodarstw ekologicznych powinny być dopłaty, jako rekompensata za świadczenie usług na rzecz dobra publicznego, czyli gospodarowania w warunkach ograniczeń wynikających z ochrony środowiska przyrodniczego.
Słowa kluczowe*: znaczenie gospodarcze i przyrodnicze trwałych użytków zielonych, zaniechanie użytkowania łąk i pastwisk, degradacja rolniczych obszarów wiejskich, łąkarskie gospodarstwa ekologiczne*

1. Introduction

Stability of permanent grasslands in Poland has recently been endangered. Despite the fact that they guarantee food security and biological diversity, despite their cultural and social importance, their area has recently decreased as has the level of their management [16, 25, 72].

The loss of stability and economic importance of grasslands limits their protective functions. Simplified landscape structure, large areas of monoculture crops, prevalence of arable lands in agricultural lands and unfavourable crop structure with 80% of cereals pose a threat to the natural environment.

Decreased area of permanent grasslands and unfavourable crop structure is accompanied by a small stock of ruminants – basic consumers of bulk fodder from grasslands. A lack of manure means a threat of negative balance of soil organic matter and of unbalanced fertilisation (due to high prices of mineral fertilisers). Less effective management of nitrogen and phosphorus increases the environmental impact of grasslands including the impact on water quality [38, 17].

In view of environmental threats to rural areas associated with declining economic use of permanent grasslands and increasing prevalence of arable lands over grasslands, finding a complex solution for maintaining grasslands, which would also stimulate their protective functions, becomes a real problem.

The aim of this study is to present productive and biological role of permanent grasslands, to show negative environmental effects of abandoning grassland management and to indicate a possibility of combining both roles through the development of organic meadow farms. Based on performed studies it was demonstrated that such farms could be a complex tool for the protection of permanent grasslands combining animal production based on natural bulk fodders with the principles of environmental protection.

2. Economic and biological importance of permanent grasslands in Poland

The importance and functions of permanent grasslands are the reflection of turf forming processes in grassland ecosystems. Turf is able to regrow permanently after mowing or grazing. Therefore, grasslands may be mown or grazed many times without any negative effect on plant viability and persistence [26, 49].

2.1. Economic importance of permanent grasslands

Permanent grasslands occupy 3.12 million ha i.e. 10% of country area and 21.4% of agricultural lands in Poland

[13]. The latter are usually too dry or too wet to allow arable use. Permanent grasslands occupy habitats inappropriate for other plant crops being an important source of fodder for animals (about 80% of fodder production areas) and significant element of habitat. They are also an important element of any farm by participating in the turnover of organic matter and inorganic components, by affecting water relations in neighbouring crops, by intercepting chemical components from arable fields and as natural habitats of many enemies of plant pests (like e.g. birds) or plant pollinators (like insects) [16]. The role of meadows and pastures in a farm depends on their share in crop structure, which determines the directions and extent of animal production.

Grassland productivity is determined by habitat conditions including soil, climatic and physiographic conditions, which are quite differentiated among particular regions of our country. Properly used meadows and pastures provide the cheapest fodder of high quality for ruminants, and that is the most natural and so far basic form of their utilisation [43, 56, 73]. Grassland production includes green fodder for direct feeding, hay, silage and hay ensilage. The share of fodder from permanent grasslands in nutritive dose of cattle varies from 50% to 100% depending on the intensity of production. Fodder value largely decides upon the quality of milk and meat products often considered as quality product [18]. Hay yields may vary from 1-2 to 10 and more tons per ha. The whole productive potential of grasslands is estimated at 30 000 ton of hay (an equivalent of 18 000 ton of cereals) [34] and its utilisation has been estimated for recent years at 60%. In 2013 mean hay yield from meadows was 5.1 t per ha and the yield of green mass from pastures was 18.8 t per ha [13].

Fodder quality of sward from permanent grasslands depends on species composition of grass communities shaped by habitat conditions and human activity. The communities, apart from grasses, include legumes. The importance of this group of plants is particularly great in sustainable, low-input and extensive agricultural systems, particularly in organic farming since they increase plant production without the need of fertilising with nitrogen in large doses. It is assumed that 1% of legumes in meadow sward „provides" 2-3 kg of atmospheric nitrogen and their 30-50% share guarantees appropriate sward density [54], improves soil structure, increases soil porosity (long root system), water capacity and humus reserves formed in turf forming processes [48]. Legume-grass sward is characterised by a higher and more stable yielding, has a higher concentration of energy and favourably balanced energy to protein ratio [41, 68, 9]. Smaller variability of chemical composition of such mixtures makes the management of grazing easier when maintaining product quality is the issue [8]. White clover is specific among legumes due to its higher protein content, smaller content of fibre and remarkable amounts of macro- and microelements and vitamins. It is also readily grazed by animals [61]. In studies of Radkowski and Radkowska [62] mass increments of young bulls and heifers grazing on quarters with a high (28 and 42%) share of white clover in sward were significantly higher. Similarly, Cosgrove et al. [4] and Crush et al. [5] obtained the increase of daily body mass increments of 4 to 16% in bulls and from 4 to 11% in heifers depending on the share of white clover in pasture sward.

Thanks to a great biodiversity, sward of permanent grasslands is characterised by persistence, resistance to varying habitat conditions, disasters, rapid changes of climate conditions etc. Obtained fodder is cheap, of good quality and highly effective in animal feeding. In Poland the cost of fodder production (calculated per oats units) on arable lands is 2.5 times higher on average than that from permanent grasslands and the fodder from sugar beets or seed maize is even 3 times more expensive [53]. The same is in countries of western EU, where the ratio of feeding cattle with green fodder from grasses, with ensilages and concentrates was calculated as 1:2:4. The precondition of profitability is high standards of grassland management [56 after Dillon et al. 2008].

Basic productive direction on permanent grasslands in Poland is still mowing and sward harvesting for hay (about 60% of the first cut and 50% of the second one) and less frequently for ensilage (15%). Although hay from meadows is important for feeding animals because of dietary reasons [63], the most rational way of cattle feeding consists in the use of meadow and pasture sward for grazing. Valuable pasture sward guarantees large increments of body mass and high meat quality. In semi-intensive and extensive systems, daily increments of body mass in beef cattle during grazing should amount 800–1000 g [1]. Green fodder from pastures is the most valuable fodder free from harvesting losses, conservation and storage [19]. Another benefit from grazing animals consists in fertilising pastures with animal faeces.

The role of grazing has recently decreased due to limited engagement of workforce, particularly in farms of a small number of workers [11, 73], to the introduction of concentrates to feed doses and to the concentration of production. All this is done at the cost of natural environment since grazing supports the protection of habitats against secondary succession and helps maintaining biodiversity, especially that of ornithofauna. Grazing reconstructs plant communities, which are breeding and feeding grounds of birds, small mammals and invertebrates. Grazing also positively affects soil and sward through delivering faeces and trampling. Movement, fresh air and sun favourably affect condition and resistance of animals to diseases through e.g. the synthesis of vitamin D and availability of herbs in fodder from pastures. This fodder may contain about 60 species of herbs and therefore, animals may utilise nutritive components and substances stimulating appetite and digestion and excreted volatile substances like essential oils (phytoncides) have medicinal properties (bacteriostatic or regulating blood pressure) [65].

Because of their multi-species composition, fodder from permanent grasslands affects the quality of meat and dairy products obtained from animals fed these fodders. Meat or milk from cows fed grasses, especially in pasture grazing, contain less fat and saturated fatty acids associated with ischemia compared with cows fed grain [56 after Couvreur et al. 2006] but more omega-3 fatty acids and more healthy ratio of omega-6 to omega-3 fatty acids (1.7 compared with 5 – 14). Grasses are rich in omega-3 and poor in omega-6 fatty acids. The ratio of omega-6 to omega-3 is: 0.4 in green fodder, 0.7 in hay and ensilage while in cereals and maize ensilage it is 14 and 5 in soya [56 after Simopolous and Robinson 1999].

There is an increasing interest in energetic use of biomass from meadow sward. Calorific value of hay is estimated at 16-17 MJ g^{-1}. For comparison, the same value of coal is 25 MJ and that of gas is 50 MJ g^{-1}. Calorific value of sward depends *i.a.* on its floristic composition [14]. Meadow sward dominated by the reed canary grass *Phalaris arundinacea* is highly valued for its high efficiency and calorific value [44]. Economic factors also indicate meadows as a better source of energetic biomass than special crops like *Miscanthus*. Production of biogas from meadow sward is also considered [10] indicating high effectiveness of biogas from sward dominated by *Lolium multiflorum*.

2.2. Biological functions of grasslands

Biological value of grasslands is the outcome of their favourable effect on environmental resources in rural areas like water, soil, air and biodiversity.

Biodiversity protection. Specific treasure of Polish meadows and pastures, mainly those used extensively, is their biodiversity including 486 species of vascular plants [45], which distinguishes them from meadows in countries of intensive or very intensive agriculture in Western Europe [37]. That is why they are a valuable gene bank, which enables maintenance of many rare and endangered species and communities.

Grasslands as feeding and breeding grounds provide life conditions for birds, invertebrates, amphibians, reptiles and small mammals [69]. The presence of species endangered worldwide like the aquatic warbler and corn crake is a treasure of Poland [7]. Population density of birds, small soil animals and rodents is an index of system sustainability. Multi-species ecosystems of pastures and meadows are more resistant to various factors like droughts than crop monocultures. Biodiversity determines aesthetic and landscape values of natural habitats [40]. Long period of flowering resulting from species diversity is a specific merit of meadows.

Protection of water resources. Storage (retention) of water. Permanent vegetation of properly used meadows and pastures takes part in controlling water relations by turning surface runoff into ground water discharge. This way the amount of water flowing out of land decreases while increasing water retention and the time of rainfall discharge to rivers. Yielding about 4.6 t of dry mass per ha permanent grasslands may retain 10-15 billion m^3 annually and 1 m thick layer of well decomposed peat has water retention capacity of 7500 m^3 ha^{-1} [72]. Soils of permanent grasslands, especially peat soils may be dealt with as natural water retention reservoirs. An increase in organic matter content in soil by 1% increases water retention in ploughed soil layer (30 cm) by 10 mm i.e. by 100 m^3 per ha during every more intense rainfall [29].

Permanent grasslands, like forests, improve water relations by dampening atmospheric air. They use much water. During the vegetation period, evapotranspiration amounts to 5 million l from one hectare of meadows and about 4.2 million l from one hectare of pastures [33]. Evaporated water returns in part (as water vapour, fog, dew or even rainfall) on the same area and in part on neighbouring grounds thus improving water relations. Moreover, grassy vegetation protects soils from excessive heating in day and from excessive cooling in night decreasing thus daily amplitude of temperature.

Biological flood control. Grasslands intercept flood waves protecting adjacent areas from flood and periodically storing water. They may play a role of the so-called flood relief grounds (or dry reservoirs) to drain flood water from riverside lands and prevent from flooding in an uncontrolled manner [47]. Early spring and spring flooding of grasslands – lasting as long as 30 days – does not make harm to plants and even stimulates their growth through fertilisation with mud. However, water retained for more than three days on land surface in summer may cause losses in plants less resistant to air deficits [48].

Water quality. Permanent grasslands play a role of the best biological filter. Compact vegetation plays a role of a filter intercepting and utilising chemical substances dissolved in rainfall. The effect depends on dense root system and well developed microbial flora, which retains suspended particles, rapidly decomposes organic matter and takes up nutrients [30, 52]. Permanent grasslands usually situated between river and arable lands take up nitrogen and phosphorus from water thus protecting against their runoff to running surface waters. Grasslands take up about 90% of nitrates penetrating their root systems [38, 29]. The amount depends on the way and frequency of sward utilisation. Nitrogen release is smaller in alternating use i.e. subsequent mowing and grazing than in one-way use (*e.g.* grazing only) [6].

Soil protection. Protection against erosion. An important role of permanent grasslands consists in their anti-erosion function. Erosion negatively affects soil fertility and crop conditions and contributes to the pollution of surface waters. Soils devoid of plant cover are the main objects of erosion. Due to a lack of permanent plant cover the amount of soil washed out increases from several to several tens of ton per ha per year. This process results in decreases of the thickness of humus layer, in washing out of the upper – most valuable – soil horizon and in changes of the grain size structure. The extent of erosion depends on the form of agricultural use of lands. Permanent and strongly rooted turf of permanent grasslands mitigates the effects of violent rainfall or wind, does not allow for condensing soil surface and protects against wind erosion. In the mountains, grasslands prevent soil from washing out of, protect it against wind erosion from slopes [33, 70] and are a specific filter intercepting and utilising chemical substances dissolved in rainfall waters [74]. A lack of permanent plant cover results in substantial increase in washed out soil amounting to 74 thousand kg ha^{-1} of soil lost annually from tuber crops as compared with only 51 kg ha^{-1} losses from pasture [35 after Starkel et al. 1978, 36]. Nutrients and pesticides washed out by water erosion tend to pollute surface waters.

Protection from degradation. Compact turf of permanent grasslands reduces the pressure of heavy machines and grazing animals on soil, protects organic soils against excessive mineralization and secures from raising and falling of soil surface during winter frosts. In grassland soils roots, runners and above-ground plant parts decompose and form organic matter (humus), which improves soil structure and fertility and increases the content of plant available water [39, 49].

Air protection. Compact communities of permanent grasslands produce more oxygen than other crops since they produce near-surface, relatively compact layer and intensive photosynthesis lasts throughout the whole vegetation season. Carbon dioxide is by 50% heavier than air and its concentration in the near-surface layer is higher and easily taken up by plants. Field of average agricultural crop takes up about 150 kg CO_2 per ha daily [60]. Permanent grasslands are therefore carbon store. It is estimated that grasslands produce at least 10 ton per ha of oxygen during the vegetation season, the amount nearly the same as in forests. Photosynthetically absorbed carbon dioxide decreases its emission to atmosphere and indirectly limits the effects of climate warming. According to Ronald and Debbie [64], meadows and pastures accumulate 20% of CO_2 released to the atmosphere by deforestation and agriculture worldwide.

3. Environmental consequences of changes in the use of permanent grasslands

Sward utilisation or systematic removal of biomass is the basic condition for the existence of permanent grasslands. Limitation of their surface area and mainly the decreasing production observed recently is followed by economic (the loss of productive potential) and biological (degradation of soils and floristic composition) losses. Studies by Nadolna [51] showed that leaving mown sward on meadow limited floristic richness and diversity. Burzyńska [2, 3] demonstrated that the same procedure affected ground water quality due to migration of nitrogen, potassium, phosphorus, magnesium and organic carbon out of the root zone of meadow vegetation (to ground waters).

Quite often, small changes in grassland management (like drainage or abandonment of mowing or grazing) result in floristic and faunistic changes. Uncontrolled changes in water conditions may lead to worsening of economic and biological quality [31]. Meadows rich in nitrogen situated on wet peat-muck soils release small amounts of nitrogen (about 65 kg per ha annually) while the release of nitrogen from meadows on dry grounds is about 303 kg per ha and from ploughed meadows – as much as 346 kg per ha [72 after Grzyb 1967]. Degraded meadow vegetation only partly utilises nitrogen from organic matter mineralization. The remaining part can cause negative environmental effects, for example pollution of groundwater by nitrates [11, 30, 55, 66].

Too intensive utilisation is not favourable for natural environment. Such management results in decreased biodiversity, soil acidification, release of nitrates, emission of harmful gases (methane, nitrogen oxides, ammonia) to atmosphere, destruction of sward due to excessive grazing etc. [15]. Even the height and frequency of mowing may affect floristic and chemical composition of plants, the ratio of generative to vegetative shoots, root length and indirectly - rainfall infiltration, and uptake and transport of substances to upper soil layers.

Grassland used exclusively as mown meadow initially supports species diversity but later leads to species impoverishment. For example, birds avoid mown meadows and inhabit grazed ones. The abandonment of mowing in the Biebrza National Park for 7 years worsened the utility value of plant communities because of increasing share of trees and decreasing area of turf cover [67]. Decreasing number of cuts increased the number of species in meadow sward [42], whereas early mowing decreased the number of species due to limited generative reproduction [46].

Long exclusively pastoral use favours the share of common species in sward with nitrophilous dicotyledon weeds in place of leftovers [27]. The optimum is alternating utilisation of mown and grazed meadow with extensive grazing that provides floristic composition optimum for agricultural production and maintains biological values. Such management ensures maintenance of strong and springy turf, which determines proper management and better fulfilment of environmental functions.

Fertilisation is the direct and most environmentally „aggressive" element of the intensification of production. Indirect elements include the concentration of animal production, intensive forms of feeding (concentrates) and fodder additives (hormones, antibiotics). Increased fertilisation, especially with nitrogen and phosphorus, decreases the number of species in sward [42]. Limited fertilisation facilitates biodiversity of permanent grasslands. Out of two doses of nitrogen applied on mountain meadow (90 and 180 kg ha^{-1}), the smaller one provided better equilibration. The abandonment of fertilisation limited yielding but short term abandonment (for one year) might recover habitat equilibration by immobilisation of nutrients and by creating favourable conditions for the growth of other plant species like low grasses [32]. At higher altitudes biodiversity is smaller in less fertile habitats [28]. Soils, particularly organic soils become degraded due to decreasing organic matter content and water capacity. Excessive fertilisation with nitrogen and acidification result in the retreat of legumes indispensable in agriculture, especially in organic one.

Basic conditions for the persistence of permanent grasslands include:

- adaptation of the intensity of management to local conditions,
- equilibration of nutrient cycling in a farm,
- fertilisation mainly with farm manure, which means a big animal production based on fodder from the own farm [26].

4. Role of permanent grasslands in the development of organic farming and perspectives of this farming in Poland

Basic conditions for the persistence of permanent grasslands [26] coincide with the principles of organic farming – the system of equilibrated plant and animal production within a farm, the system, which does not disturb natural equilibria but promotes maintenance of natural resources like soil and water. This type of farming attempts to function in a close cycle soil – plant – animal with a great deal of self-sufficiency. Quality and not maximization of production is the priority [50].

Agricultural production in organic farms is based on animal production, which provides organic matter and nutrients to soil thus improving its status. Organic animal breeding should be associated with agricultural lands, with grasslands at best, which guarantee the access to corrals and pasture grazing and with feeding with organic fodder from own farm. The time of converting a farm to organic system depends on the specifics of permanent grasslands and may last only one year (for other crops it lasts 2 years). This is the time of purifying soil from plant protection chemicals.

Permanent grasslands are the most important source of fodder for ruminants, whose manure is indispensable for arable lands and grasslands in organic farms. Due to the use of legumes as an important source of nitrogen for grasses, there is no risk of polluting waters with nitrates. Fodder is also free from the excess of nitrates. Grazing is an element of animal welfare. It affects biodiversity and eliminates environmental threats. Species richness (herb species in that number) improves fodder palatability and digestion in fed animals and finally affects the quality of obtained products (milk and meat).

Analyses of food produced in organic farms confirm its better healthy, nutritive, olfactory and tasty values than that produced conventionally. In meat of animals fed on organic pasture Walczak [71] found higher content of vitamin E and greater share of CLA, PUFA and the ratio of omega-6 to omega-3 fatty acids. Therefore, food produced in organic farms arouses more and more interest. Moreover, the potential of permanent grasslands – the only crop protecting natural environment - is still not fully utilised. Permanent grasslands occupy 54% of the area of organic farms in Poland (data from 2009, GIJHARS) and 35.3% of agricultural lands (data from 2012). These data confirm specific role of permanent grasslands in organic farming and indicate the need of its development in Poland

The number of organic farms controlled by certifying institutions increased more than 11-fold from 2286 in the year 2003 to 25613 in 2014. Most organic farms are situated in Warmińsko-Mazurskie, Zachodniopomorskie and Podlaskie provinces. Mean area of organic farm varied from 20.71 to 25.19 ha (about 25 ha in the years 2010 – 2013) while the mean area of conventional farm was about 10 ha. The largest areas occupied by organic farming in the year 2013 were noted in Zachodniopomorskie (143 648.2 ha), Warmińsko-Mazurskie (140 845.3 ha) and Podlaskie (63 599.4 ha) Province. The whole area of organic farms in 2013 was 675 thousand ha (by 2% more than in 2012), which constitutes 4% of all agricultural lands in Poland.

The development of organic farming in Poland is facilitated by ecological quality of agricultural productive space, by its biodiversity and, paradoxically, by low level of the part of agriculture, where the switch from conventional to organic farming is not followed by a rapid decline of yields as is the case with intensively managed farms. Moreover, the development of agro-tourism increases the interest in spending holidays in farms offering organic products. Organic farming helps utilising large reserves of workforce being at the disposal of Polish agriculture. In 2010 there were 1897.2 thousand of fully employed workers i.e. 13.1 workers per 100 ha compared with 6.2 workers employed in the EU [57].

Prospective may be the extensive production of beef cattle and sheep, which does not require large investments (cowsheds, dairy factories) and is justified in areas of large percent of permanent grasslands, even those managed very extensively. In the case of beef cattle, sward quality is of lesser importance.

Possibilities of improving utilisation of permanent grasslands in organic animal farming were confirmed by studies carried out in the former IMUZ. Organic fertilisers, mainly manure, are useful in fodder production on organic grasslands. Their application brought increasing yields and better nutritive value of green fodder without worsening microbial quality [23, 24].

All farms with a large (>30%) percent of grasslands carried animal production, mainly dairy cattle and animal stock was 2 to 2.5 times higher than the country mean. Feeding was based on bulk fodder with concentrate additives mainly from own farm. Mean share of permanent grasslands was 49.9%. Most grasslands were not fertilised except for animal faeces on pastures. Yields of green mass were 22 $t \cdot ha^{-1}$ (at 15-17 t of the country mean). The share of fodder from grasslands in the total balance of bulk fodder was 71% on average. In 70% of analysed farms utilisation of permanent grasslands for animal production was markedly better than in conventional farms of the same province. In the remaining 30% of farms there were large fodder reserves [22].

Results of chemical analyses of fodder obtained from grasslands of studied farms were less optimistic but generally fell within limits considered as optimum. The richest fodder of best digestibility (66% on average) was green fodder from pastures and the poorest fodder (64% digestibility) was hay [24, 22]. Soils of grasslands were slightly acidic and acidic but in only 23% of farms liming was considered necessary (pH<5). The content of nutrients in soils was differentiated. For example, the content of plant available phosphorus was small (< 10 mg/100 g of soil), that of potassium was very high and the content of magnesium and calcium – exceptionally favourable. These data were confirmed by nutrient balances made with the method "at the farm gate". Despite limited sources of nitrogen, most farms showed its excess in amount of 20-30 kg N/ha, and substantial deficits of phosphorus and potassium [24].

Generally low level of gross margin in most farms had a clearly raising trend. Classification of agricultural types and economic size of analysed organic farms showed that 40% of them belonged to economic class „moderately large" of best economic results and these were the farms *„specialising in dairy cattle breeding in the pastoral system"*. Similarly good economic results (or even better when calculated per person) were obtained by farms of large areas of agricultural lands, small workforce resources specialising in beef cattle breeding (65 thousand PLN as opposed to 36 thousand PLN in dairy cattle breeding). Subsidies constituted about 40% of direct surplus in farms. They guaranteed economically effective production of high quality food [58, 59].

A chance for further development had 80% of analysed farms so a bit more than in conventional farms [20, 21]. One may expect that meadow organic farms oriented to milk and meat production may function well and become an effective way of maintaining permanent grasslands.

5. Conclusions

Permanent grasslands occupy more than 21.4% of agricultural lands in Poland. They grow in habitats of poor or very poor soils inappropriate for growing other crops. Nevertheless, they are a significant source of fodder for animals (about 80% of area used for fodder production), and important element of habitat and farm. The occurrence of legumes in grassland sward limits the demand for nitrogen from fertilisers, which is important in sustainable, low-cost or organic farming. Legumes improve soil structure, increase its porosity and water capacity and stimulate turf forming processes. Thanks to its great biodiversity, grassland sward is stable, resistant to variable habitat properties, rapid changes of climatic conditions, disasters etc. Properly managed grasslands provide the cheapest and highly valuable fodder for ruminants, which affects the quality of meat and dairy products.

The area covered by permanent grasslands has recently dramatically decreased in Poland. The level of yielding and farming has decreased as well. Grazing is being abandoned in favour of grassland mowing or total abandonment of grassland farming. The main reason is too small stock of ruminants (the main consumers of plant biomass) and striving for maximum efficiency in milk production. The effect is the degradation of grassland sward and soil, which brings notable economic (the loss of fodder for animals) and environmental losses. This way the potential of meadows and pastures for providing ecosystem services (basic, supplying, regulatory and cultural) is threatened since biological value of grasslands is an outcome of their favourable effect on environmental resources such as water, soil, air and biodiversity in rural areas.

In view of permanent trend of declining level of grassland management and decreasing of their area, and because of combined productive and protective function of grasslands it is necessary to preserve and maintain these lands in good condition.

Systematic and rational use is the precondition of good status of permanent grasslands. This means the recovery of ruminant stock directed into milk or meat production. Such an effect may be provided by economically profitable meadow organic farms breeding animals. Organic farming guarantees the use of natural fertilisers, biomass uptake and nutrient cycling that minimises environmental impact of production. Profitable management of permanent grasslands is possible on condition of improving technology and its implementation in farms. There are great reserves in better knowledge of grassland management, particularly of organic farming. Subsidies as a compensation for services provided for the common good i.e. for the management under limitations resulting from environmental protection should guarantee profitability of grassland farming.

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